

FIG. 1

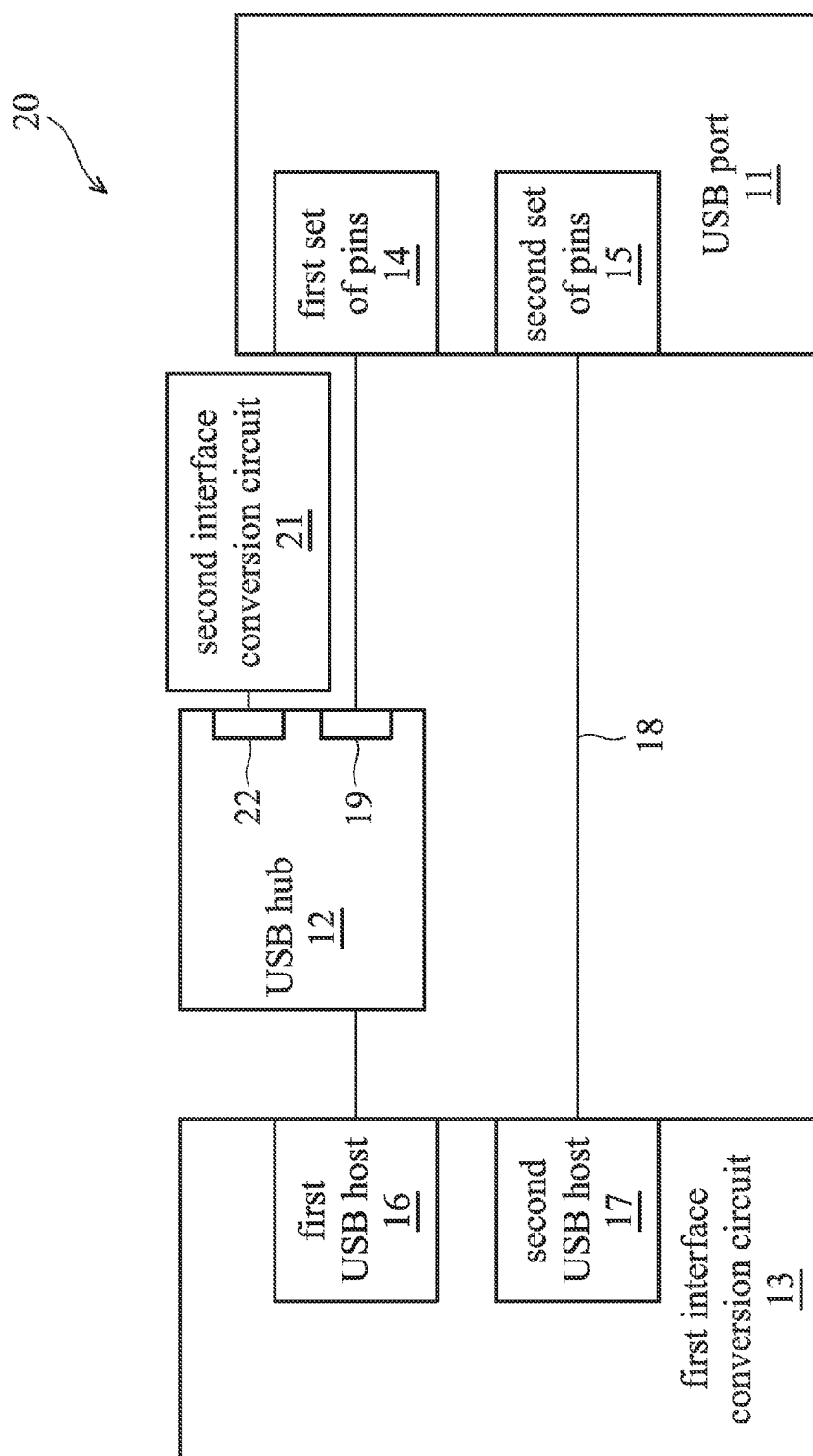


Fig. 2

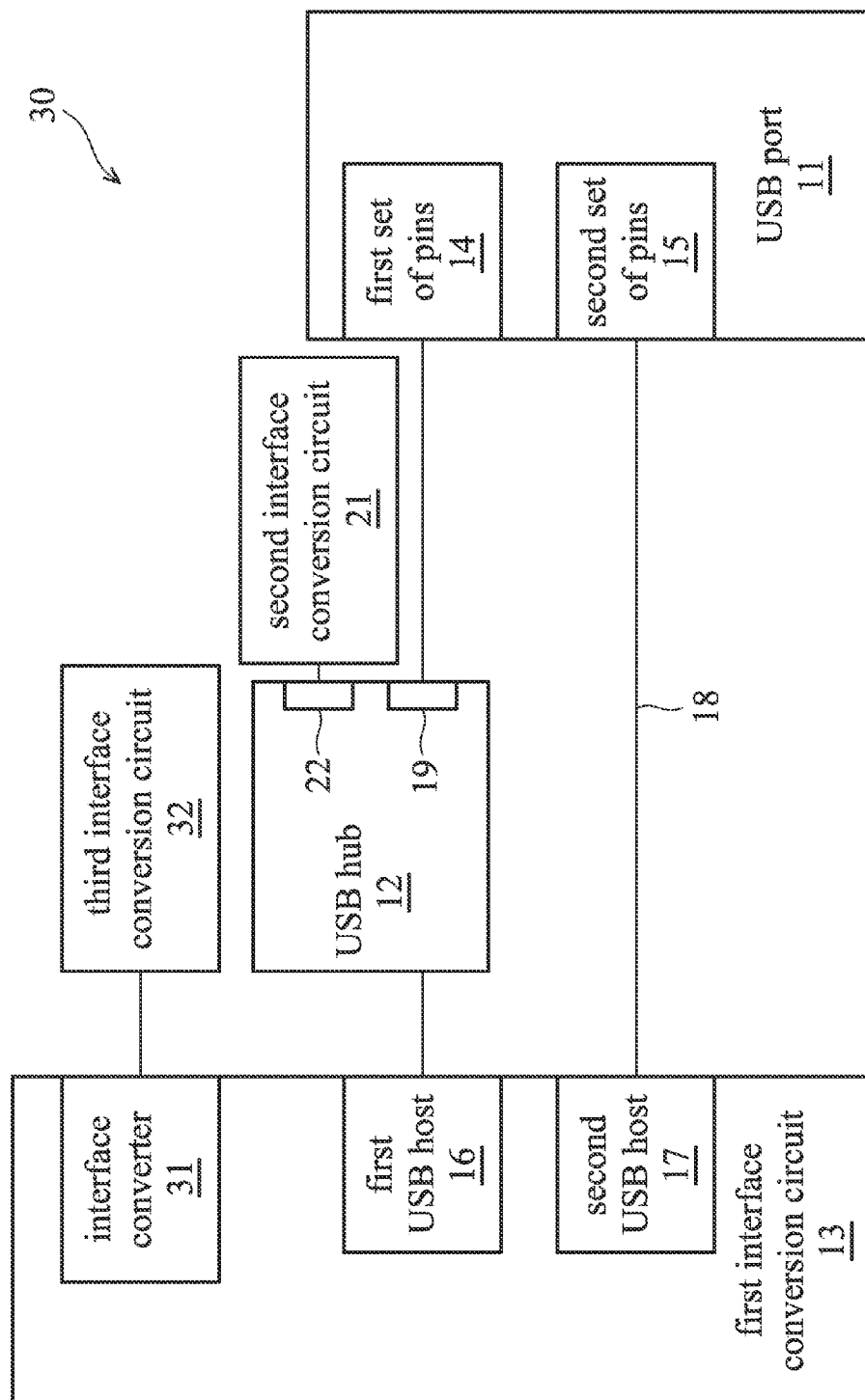


FIG. 3

1

# INTERFACE EXTENSION DEVICE COMPATIBLE WITH USB 2.0 AND USB 3.0 STANDARDS

## CROSS REFERENCE TO RELATED APPLICATION

This Application claims priority of Taiwan Patent Application No. 101149459, filed on Dec. 24, 2012, the entirety of which is incorporated by reference herein.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to an interface extension device, and in particular, to an interface extension device compatible with USB 3.0.

### 2. Description of the Related Art

Recently, the design of notebook computer has trended towards a slimmer profile, and the bulky input and output (I/O) interfaces are removed, with only a few I/O interfaces being preserved in current designs in order to make the notebook thinner and lighter. For example, the network connector (i.e. RJ45 connection port) and VGA port are removed, leaving only a small number of USB ports or Mini display ports. However, users sometimes still need to use these removed I/O interfaces. Therefore, a dongle is conventionally used to provide users with the functions of I/O interfaces. Traditionally, a dongle compatible with USB 3.0 must have a USB 3.0 Hub configured to support the I/O interface of USB 3.0. However, the cost of the USB 3.0 hub is still high, such that the cost of a dongle compatible with USB 3.0 is too high.

## BRIEF SUMMARY OF INVENTION

A detailed description is given in the following embodiments with reference to the accompanying drawings.

The present invention provides an interface extension device compatible with USB 2.0 and USB 3.0 standards. Also, the interface extension device only uses a USB 2.0 hub.

An embodiment of an interface extension device is disclosed. The interface extension device includes a USB port, a USB hub, and a first interface conversion circuit. The USB hub has a first port connected to the USB port. The first interface conversion circuit includes first and second USB hosts. The first USB host is connected to the USB hub and is connected to the USB port through the USB hub. The second USB host has a bus and is directly connected to the USB port without routing through any USB hub.

Another embodiment of an interface extension device is also disclosed. The interface extension device includes a USB port, a USB hub, a first interface conversion circuit, and a second interface conversion circuit. The USB hub has a first port connected to the USB port. The first interface conversion circuit includes a first USB host, a second USB host, and an interface converter. The first USB host is connected to the USB hub and connected to the USB port through the USB hub. The second USB host has a bus, and is directly connected to the USB port without routing through any USB hub. The interface converter is configured to convert the signal compatible with a lightning bolt interface to a display port signal. The second interface conversion circuit is configured to convert the display port signal to a VGA signal, and output the VGA signal to a VGA port. Wherein the USB hub further comprises a second port

2

connected to a third interface conversion circuit, and configured to convert a USB signal from the first USB host to a network package, and convert the network package to the USB signal.

Another embodiment of an interface extension device is disclosed. The interface extension device includes a USB port, a USB hub, a first interface conversion circuit, and a second interface conversion circuit. The USB hub has a first port connected to the USB port. The first interface conversion circuit includes a first USB host, a second USB host, and an interface converter. The first USB host is connected to the USB hub and connected to the USB port through the USB hub. The second USB host has a bus, and is directly connected to the USB port without routing through any USB hub. The interface converter is configured to convert the signal compatible with a lightning bolt interface to a display port signal. The second interface conversion circuit is configured to convert the display port signal to a VGA signal, and output the VGA signal to a VGA port. Wherein the USB port comprises a first set of pins and a second set of pins, the first set of pins and the second set of pins are connected to a connector compatible with USB 2.0 and a connector compatible with USB 3.0, respectively, and the USB hub is a USB 2.0 hub.

## BRIEF DESCRIPTION OF DRAWINGS

The present invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

FIG. 1 is a diagram showing an embodiment of an interface extension device of the invention;

FIG. 2 is a diagram of another embodiment of the interface extension device of the invention; and

FIG. 3 is a diagram of another embodiment of the interface extension device of the invention.

## DETAILED DESCRIPTION OF INVENTION

The following description is of the best-contemplated mode of carrying out the invention. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. The scope of the invention is best determined by reference to the appended claims.

FIG. 1 is a schematic diagram of an interface extension device according to an embodiment of this disclosure. As shown in FIG. 1, the interface extension device 10 comprises a USB port 11, a USB hub 12 and a first interface conversion circuit 13. For example, the interface extension device 10 can be a docking or a dongle, but it is not limited thereto. The first interface conversion circuit 13 is configured to connect the interface extension device 10 to other devices, such as a notebook, a desktop or a hub, but not limited thereto. The I/O port connected to the first interface conversion circuit 13 can be an I/O port compatible with USB 2.0 and/or USB 3.0 or a Mini Display Port compatible with the lightning bolt interface, but it is not limited thereto. The first interface conversion circuit 13 further comprises a first USB host 16 and a second USB host 17. The first USB host 16 is a USB 2.0 host and the second USB host 17 is a USB 3.0 host. Operations of the first USB host 16 and the second USB host 17 are the same as traditional USB 2.0 host and traditional USB 3.0 host respectively, so details thereof are omitted for brevity. The first USB host 16 is connected to the USB hub 12, and is connected to the USB port 11

3

through the USB hub **12**. The second USB host **17** has a bus **18**, and the second USB host **17** is directly connected to the USB port **11** without routing through any USB hub.

In one embodiment, when the first interface conversion circuit **13** is connected to a notebook supporting USB 3.0, the USB signals from the notebook would be delivered to the first USB host **16** and the second USB host **17** simultaneously, due to the standard of the USB 3.0 having the characteristics of downward compatibility. In another embodiment, when the first interface conversion circuit **13** is connected to the notebook supporting USB 2.0, the signal from the notebook would only be delivered to the first USB host **16**. In another embodiment, when the first interface conversion circuit **13** is connected to the mini display port of the notebook supporting the lightning bolt interface, the signals from the notebook would be delivered to the first USB host **16** and the second USB host **17**, respectively.

The USB hub **12** is configured to deliver the signal from the first interface conversion circuit **13** to the USB port **11** or to deliver the signal from the USB port **11** to the first interface conversion circuit **13**. In this embodiment, the USB hub **12** is the hub compatible with USB 2.0. The USB hub **12** further delivers the signal from the first USB host **16** to other USB ports compatible with USB 2.0 standard. The operation of the USB hub **12** is the same as the conventional USB 2.0 hub, and thus the details thereof are omitted for brevity. The USB port **11** has a first set of pins **14** and a second set of pins **15**, and the first set of pins **14** and the second set of pins **15** are compatible with the connectors of USB 2.0 and USB 3.0, respectively. In the present embodiment, the first set of pins **14** are electrically connected to a first port **19** of the USB hub **12** while the second set of pins **15** are directly electrically connected to the bus **18** of the second USB host **17**. In other words, in the present embodiment, the USB port **11** has a slot (not shown) arranged to connect to a plug compatible with USB standard, and this plug can be compatible with USB 2.0 and USB 3.0. For example, the external device connected to the USB port can be a product (i.e., a keyboard, a mouse, a printer, a flash drive, a camera, a hub, an external hard drive, a Bluetooth device, or a card reader) compatible with USB I/O interface standards, but it is not limited thereto.

According to the I/O interface of the external device connected to the interface extension device **10**, the interface extension device **10** has the following operations. When the external device is connected to the USB port **11** through the connector compatible with the USB 2.0, the first USB host **16** communicates with the external device through the USB hub **12**. When the external device is connected to the USB port **11** through the connector compatible with the USB 3.0, the second USB host **17** directly communicates with the external device through the bus **18**. Therefore, the interface extension device **10** can enable a first external device connected to the first interface conversion circuit **13** to communicate with a second device connected to the USB port **11** using USB 3.0 standard or USB 2.0 standard without the USB 3.0 hub.

FIG. 2 is another schematic diagram of the interface extension device according to another embodiment of this disclosure. As shown in FIG. 2, the interface extension device **20** is similar to the interface extension device **10** shown in FIG. 1. The difference is in that the interface extension device **20** further comprises a second interface conversion circuit **21**, and the USB hub **12** further comprises a second port **22**. The second interface conversion circuit **21** is configured to convert the signal from the first USB host **16** to network packages, and to convert the network packages

4

to the USB signal. For example, the second interface conversion circuit **21** has a slot configured to connect to the RJ45 network connector of the external device. Furthermore, the second interface conversion circuit **21** converts the signal from the first USB host **16** into the network packages through the USB hub **12**, and delivers the network packages to the external device connected to the second interface conversion circuit **21** for communication. For example, the external device connected to the second interface conversion circuit **21** can be a computer, a hub, a switching hub, or an IP switcher, but it is not limited thereto. The connector connected to the external device of the second interface conversion circuit **21** can be a RJ45 compatible connector, but it is not limited thereto. Therefore, the interface extension device **20** can enable a first external device connected to the first interface conversion circuit **13** to communicate with a second external device connected to the USB port **11** using USB 3.0 or USB 2.0 standard, and enable the first external device to transfer the network packages to and receive the network packages from a third external device connected to the second interface conversion circuit **21**.

FIG. 3 is another schematic diagram of the interface extension device according to another embodiment of this disclosure. As shown in FIG. 3, the interface extension device **30** is similar to the interface extension device **20** shown in FIG. 2. The difference is in that the interface extension device **30** further comprises a third interface conversion circuit **32**, and the first interface conversion circuit **13** further comprises an interface converter **31**. The interface converter **31** is configured to convert the signal compatible with a lightning bolt interface to a display port signal, and the third interface conversion circuit **32** is configured to convert the display port signal to a VGA signal. For example, the external device connected to the third interface conversion circuit **32** can be a computer monitor, a monitor, a projector, or a television, but it is not limited thereto. The connector connected to the external device and the third interface conversion circuit **32** can be a connector compatible with the standard of the VGA port or DVI, but it is not limited thereto. In an embodiment, a projector can be connected to the third interface conversion circuit **32** by the VGA connector. In another embodiment, the interface extension device **30** is connected to a connector compatible with the lightning bolt interface of the notebook, and a USB hard disk compatible with the standard of USB 3.0 can be enabled to communicate with the notebook under the standard of USB 3.0 through the USB port **11**. Furthermore, the notebook can also be connected to the external network device through the second interface conversion circuit **21** of the interface extension device **30**, and outputs images to an external projector through the third interface conversion circuit **32**, simultaneously.

Therefore, the interface extension device **30** can enable a first external device connected to the first interface conversion circuit **13** to communicate with a second external device connected to the USB port **11** compatible with the standard of USB 3.0 and USB 2.0, without a USB 3.0 Hub. In addition, the interface extension device **30** can also enable the first external device to transfer a network package to or to receive a network package from a third external device connected to the second interface conversion circuit **21**. Furthermore, the interface extension device **30** can further enable the first external device to transfer images with a fourth external device connected to the third interface conversion circuit **32**.

Above all, the interface extension device in the present disclosure can provide the transmission compatible with the

5

standard of USB 3.0 without using the USB 3.0 hub, and thus, the production cost of the entire interface extension device can be reduced.

While the invention has been described by way of example and in terms of the preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. On the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

What is claimed is:

1. An interface extension device, comprising:

a USB port;

a USB hub, having a first port connected to the USB port; and

a first interface conversion circuit, comprising:

a first USB host, connected to the USB hub and connected to the USB port through the USB hub; and

a second USB host, having a bus and being directly connected to the USB port without routing through any USB hub, wherein the USB port comprises a first set of pins and a second set of pins, and the first set of pins and the second set of pins are arranged to connect to a connector compatible with USB 2.0 and a connector compatible with USB 3.0, respectively, and the USB hub is a USB 2.0 hub, wherein when an external device is connected to the USB port through the connector compatible with USB 3.0, the second USB host directly connects to the external device through the bus and the second set of pins of the USB port rather than any USB hub and communicates with the external device, wherein the USB hub further comprises a second port connected to a second interface conversion circuit, and configured to convert a USB signal from the first USB host to a network package, and convert the network package to the USB signal;

wherein the first USB host communicates with the external device through the USB hub and the first set of pins of the USB port, when the external device is connected to the USB port through the connector compatible with USB 2.0.

2. The interface extension device as claimed in claim 1, wherein the first interface conversion circuit further comprises an interface converter configured to convert a signal compatible with a lightning bolt interface to a display port signal, and the interface extension device further comprises a third interface conversion circuit configured to convert the display port signal to a VGA signal and output the VGA signal to a VGA port.

3. The interface extension device as claimed in claim 1, wherein the interface extension device is a docking or a dongle.

4. An interface extension device, comprising:

a USB port;

a USB hub, having a first port connected to the USB port;

a first interface conversion circuit, comprising:

a first USB host, connected to the USB hub and connected to the USB port through the USB hub; a second USB host, having a bus and directly connected to the USB port without routing through any USB hub, wherein the USB port comprises a first set of pins and a second set of pins, the first set of pins and the second set of pins are connected to a connector compatible with USB 2.0 and a connector compatible with USB 3.0, respectively, and the USB hub is a USB 2.0 hub, wherein when an external device is connected to the USB port through the connector compatible with USB 3.0, the second USB host directly connects to the external device through the bus and the second set of pins of the USB port rather than any USB hub and communicates with the external device; and

an interface converter, configured to convert a signal compatible with a lightning bolt interface to a display port signal; and

a third interface conversion circuit, configured to convert the display port signal to a VGA signal, and output the VGA signal to a VGA port;

wherein the USB hub further comprises a second port connected to a second interface conversion circuit, and configured to convert a USB signal from the first USB host to a network package and convert the network package to the USB signal; and

wherein the first USB host communicates with the external device through the USB hub and the first set of pins of the USB port, when the external device is connected to the USB port through the connector compatible with USB 2.0.

5. An interface extension device, comprising:

a USB port;

a USB hub, having a first port connected to the USB port;

a first interface conversion circuit, comprising:

a first USB host, connected to the USB hub and connected to the USB port through the USB hub;

a second USB host, having a bus, and directly connected to the USB port without routing through any USB hub, wherein the USB port comprises a first set of pins and a second set of pins, the first set of pins and the second set of pins are connected to a connector compatible with USB 2.0 and a connector compatible with USB 3.0, respectively, and the USB hub is a USB 2.0 hub, wherein when an external device is connected to the USB port through the connector compatible with USB 3.0, the second USB host directly connects to the external device through the bus and the second set of pins of the USB port rather than any USB hub and communicates with the external device; and

an interface converter, configured to convert a signal compatible with a lightning bolt interface to a display port signal; and

a third interface conversion circuit, configured to convert the display port signal to a VGA signal and output the VGA signal to a VGA port.

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6